Mass Media vs. the Mass of Media: a Study on the Human Nodes in a Social Network and their Chosen Messages

Sabbar, Shaho; Matheson, Donald

Veröffentlichungsversion / Published Version
Zeitschriftenartikel / journal article

Empfohlene Zitierung / Suggested Citation:
Sabbar, S., & Matheson, D. (2019). Mass Media vs. the Mass of Media: a Study on the Human Nodes in a Social Network and their Chosen Messages. *Journal of Cyberspace Studies*, *3*(1), 23-42. https://doi.org/10.22059/jcss.2019.271467.1031

Original Article

Mass Media vs. the Mass of Media: A Study on the Human Nodes in a Social Network and Their Chosen messages

Shaho Sabbar*
Donald Matheson

(Received 19 December 2018; accepted 30 December 2018)

Abstract
In Internet-based social networks, the nodes have the most pivotal role in the processes and outcomes of the networks. Whether they pay attention to a message in the network or ignore it defines the fate of the message. One message is shared and re-shared by millions of users and another is left forgotten. The current study tries to shed light on one aspect of the role of the users in a social network: How are people different in the types of messages to which they pay attention? Some 500 Facebook users were interviewed and a creative method was used to find the public Facebook messages on which they had commented. Then, the researchers coded the data into different categories and carried out statistical analyses looking for significant relations between the types of Facebook users and the types of messages on which they commented. The results of the study include 21 significant relations, suggesting that the approach taken by this study can be promising and if completed by several other studies it could help us find local and universal patterns that affect the flow of information. With enough knowledge on social networks we must be able to design specific messages, for specific groups of people.

Keywords: Facebook, information flow, social networks, message characteristics, network behavior

Shaho Sabbar: (Corresponding author) Assistant Professor, University of Tehran, Tehran, Iran- Email: shaho.sabbar@ut.ac.ir

Donald Matheson: Head of Department, Media and Communication, University of Canterbury, England- Email: donald.matheson@canterbury.ac.nz

Introduction

The development from a society based on mass media to one based on digital networks has necessitated a shift in audience studies. While, in the past, *audience perception* was the foremost research goal, now *audience behavior* seems to be of more importance. The difference lies in a significant change in the role played by the audience in the age of information networks.

Flow of information in a society can be assumed to have two stages: 1. one-to-many spread of information; 2. many-to-many spread of information. The former consists of the transmission of pieces of information from a mass distributor to the first-layer receivers. The second stage is the one in which the information spreads from the initial receivers to other nodes in the network.

Different studies have focused on these two stages. Scholars working on such concepts as Word of Mouth and Viral Marketing are mainly concerned with the second stage involving the diffusion of information among the nodes of the network (see Camarero & San José, 2011; Pescher et al., 2014; Pescher & Spann, 2014). Not only the diffusion of various types of information but also the diffusion of the effects of information (such as *expectations*, *opinions and adoption*) have been studied by the scholars concerned with the second stage of flow of information (see Besley & Baxter-Clemmons, 2010; Granato et al., 2011; Ramirez et al., 2014).

In every society these two levels of information transmission exist because in all networks some nodes have more connections, access to more information, and enjoy more salient position as a sender rather than receiver. Therefore, in any society there are some nodes that send many units of information to several nodes and there are many nodes that usually receive information from other nodes and deliver them to a limited number of others.

This was the case in ancient societies where the king would send a number of messengers to different cities to gather people in a central location and convey to them the royal message. People, in turn, would deliver the message to others who had not shown up. It is also true in a modern society where the dominant form of communication is the result of the work of mass media. Here, the media are usually the mass distributors of information (even though they might not be the creators of them), and the people who receive the information from the media and pass them to others, construct the many-to-many stage of the flow.

A similar pattern exists in the age of the Internet and digital network society. Here too, there are nodes such as governments, scientific centers, television networks and mainstream news networks (online or

traditional) which have far more connections than an average member of the society does. They provide numerous nodes in the network with information and these nodes, in turn, pass the information on, deeper and wider in the network.

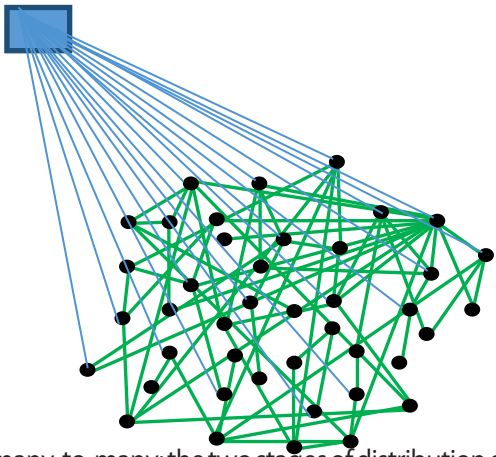

Figure 1. One-to-many & many-to-many: the two stages of distribution of information

However, despite the similarity, there seem to be at least four substantial differences in the latter case where a considerable number of the nodes communicate through the Internet: First, the average node has significantly more connections. It is still true that an average node in the network has far fewer connections compared to the mass senders of information and also attempts less to distribute information. However, a node in this network has incomparably more communicative potentials than a node in the pre-Internet era.

After reading a story in the papers, if one finds it really interesting, he might talk about it to one, two, or perhaps more friends and colleagues. Here, 10 could be considered as *many* cases of information sharing. But if one is an active Internet user, they might simply share the information they receive with hundreds of people through Twitter, mailing lists, Facebook, weblogs, etc.

Second, other than the number of connections, the capacity of information delivery has revolutionarily changed in a digital network society. In physical life, how many issues can a person keep in mind every day and how much time would they have to share those issues? Perhaps well less than ten stories per day. This number is by no means large if he or she is an active Facebook user who keeps pressing the *share* button or has a habit of *forwarding* interesting emails to others.

Thirdly, in the digital age most of us have one or many offline versions of ourselves that are busy with distributing information on our behalf even when we are sleeping. After you have abandoned your Facebook page (for instance because you are busy now and don't have much time to spend on it) your Facebook identity may still be showing your previous posts to the world and receive comments and likes.

The fourth difference concerns the fact that in the physical world most often people can only provide others with their *perception* of the pieces of information they have received, not the original ones. In a society equipped with digital networks, people redistribute the actual pieces of information originally sent by the mass distributors. They cut what they originally saw or heard into pieces of text, audio and video and simply pass them to others.

These differences have given the audiences a role more critical than just an audience. The term *mass of media* in the title of this paper refers to the increasing importance of the nodes of the network which act as numerous media, while the relative importance of mass media in the network might have been on the decline.

Other studies have shown the increased importance of the role of the average node in the network. Studying people's voting behavior, Schmitt-Beck and Mackenrodt (2010) showed that "the media's effects are generally weaker than those of social networks."

Today, almost every audience is potentially an audience/distributor and their *behavior* has gained significantly more importance than before. We can study the *perceptions* of these audiences, but if we aim to understand the flow of information in the network, what we would need to study is the *network behaviors* (Sabbar & Hyun, 2016) of these active audiences.

This research aims to propose and examine an approach to study the reactions of the human nodes towards the messages on a social network. As a preliminary work, this study will try to find out what types of messages different groups of people react to. It will do so by conducting a statistical analysis on the relations between two sets of variables that will be described later in the article.

Literature Review

It may sound surprising to claim there has not been much scholarly work on the concept of *flow of information*. Nowadays words and phrases such as communication, information flow and information network are so popular that many would presume that we know a great deal on how pieces of information flow in different networks.

The fact is while there are theories and data on general issues regarding social networks and communication at the age of the Internet, we do not know much about the factors that affect the flow of *specific units of information* in different networks. We may have some theories on how social networks and social journalism have affected democratic movements in the society but if we are asked why a specific story was ignored while another went viral, we do not have much to say.

Many of the studies on social networks have mainly used those networks as data resources. That means most studies have used social networks such as Facebook to analyze *the data/information* stored on them to study different social issues, and not to understand *how information is shared* and re-shared on these networks (see Torrente et al., 2012; Tufekci & Wilson, 2012; Valenzuela et al., 2009).

Some scholars have taken preliminary steps to understand how pieces of information are treated in a network. Kaplan and Haenlein (2011) allude to three conditions that if fulfilled a viral marketing epidemic can be created: "Giving the right message, to the right messengers, in the right environment." While that study limits itself to distinguishing the "right" message and the "right" messengers, theoretically, research can develop a detailed list of characteristics of the messages and the messengers. Also instead of limiting the work to "epidemics", one can look for different forms of the flow of information in the network.

In other words, instead of asking what the "right message" is and who the "right messenger" is to trigger an "epidemic" one can study how "different kinds of people", "different kinds of messages" and "different kinds of results" are in relation with one another.

Since Lazarsfeld and his colleagues (1944) theorized the two-step flow of information much has changed in the dynamics of the flow of information in the world. For the reasons mentioned in the introduction, beyond theories on how major currents of information pass through a society, we need micro-analyses that tell us how specific factors affect the flow of specific pieces of information in the network.

To move towards such an ambitious goal we may use all we are equipped with in different disciplines. We need a general understanding of *network theory* and we need to borrow from the findings of social network analysis, advertising, marketing and other fields. However, this objective and the study of flow of information remain complicated mainly because our knowledge about the factors influencing the flow of information is scattered between numerous fields of study.

Chafe (1987), Luce (1953) and others have offered arguments about different aspects of information flow in the field of psychology.

For example Chafe focuses on the cognitive issues regarding memory and how *temporarily active information* in the mind of a speaker is shared with an audience. Also Reitman (1978) who worked in the field of computer science, Subramanian and Katz (2011) who focused on the Internet and networks and Lehman and Burke (1981) who studied telecommunication, have addressed the issue of flow of information.

This study tried to borrow understanding from the available studies and add some using creative– and yet systematic- ways of gathering and analyzing data. Throughout the paper, some of the works that were used to better understand the field and the issue of flow of information have been mentioned.

Research Objectives

As mentioned earlier, the issue of flow of information is a multifaceted issue, in which many factors play a role and it can/should be studied from different perspectives. The current study has limited itself to one perspective and two sets of variables. Here, attempts are made to find the relations between the *characteristics of the nodes* of the network and the *type of information* they react to. In other words, this study proposes that by knowing the characteristics of the nodes of a network, we might be able to predict the kind of information they would react to.

Granato and Krause (2000) argue "more informed segments of the population acquire new information at greater speed than less informed segments of the population." However, other than *being informed*, different demographic, behavioral, knowledge-based and psychological traits of the nodes may affect their relations with the pieces of information in the network.

Facebook provides a good setting to study such relations. This study used data obtained from Facebook and tried to find significant relations between the characteristics of Facebook users on one hand and the type of Facebook posts on which they write a comment, on the other. In Facebook terms, this study tried to see if the characteristics of Facebook users could explain the types of Facebook *posts* on which they *comment*. The datasets and characteristics will be detailed in the next sections of this article.

Here information about the Facebook users should be gathered, as well as the messages posted on Facebook. Information about the characteristics of the nodes (Facebook users here) could be gained by distributing a questionnaire. Therefore, a questionnaire was prepared that covered general demographics, media consumption and personality traits of the respondents. The research team tried to convince Facebook users to fill in the questionnaires an also provide the study with their Facebook IDs.

The questionnaires were submitted through one of the three following methods:

1. Several Facebook public pages were asked to present the questionnaire to their followers and ask them to cooperate in the research project.
2. The questionnaires were submitted through Facebook private messages.
3. The questionnaires were submitted as email attachments. In the second and third cases snowball sampling was used to find Facebook users willing to cooperate.

Understandably, many people were not comfortable with filling in the questionnaires which included personal questions and at the same time let the researchers have their IDs. Eventually, 470 Facebook users filled in the questionnaires and let us have their Facebook IDs. However, gathering the second set of data was still a challenge.

The questionnaires provided the research with the needed information on the characteristics of the nodes. However, the research still had to learn what posts they had commented on. Having people's Facebook IDs does not enable one to access their private information or get a record of their past activities.

To gather the missing data, a software application was designed and coded that was capable of searching Facebook public pages and gathering a massive amount of data. The application receives the URL of a Facebook pubic page, gathers and stores all its posts as well as the comments people have written on them.

To make the work feasible by limiting its scope, the questionnaires were given only to Iranians. Then 41 popular Facebook pages were chosen (only based on the numbers of the members) and using our software application, thousands of their posts and hundreds of thousands of their comments were collected.

The 41 pages were chose in the following way: the researchers spent many hours finding as many Farsi pages as possible (which led to list of more than 3 hundred pages) then all the pages with at least 10,000 followers were picked for the automatic data gathering process.

In total, more than 2,100,000 comments, written by 900,000 Facebook users, on 1,500,000 posts were gathered. Then a search was conducted to collect the comments that were written by any of the 470 users who participated in our survey. The final selected database included 770 comments, written on 591 Facebook posts by 184 people who had participated in our survey.

At a quick glance, it might seem like the study violated the privacy of the people who took part in our survey. Regarding this issue, four points should be mentioned:

1. People who filled in the questionnaires agreed to let the researcher access their Facebook IDs;
2. Based on Facebook rules, comments that people write on public pages are considered public information (unlike what they write on their own page). The only type of information that was collected (and was possible to be collect) was this type of public information. All the collected information is accessible to any Facebook user. The only reason an application had to be designed was that without it, performing a proper search with a sufficient number of results was not possible.
3. Almost all the 184 people whose comments were studied were unknown to the researchers. However, the data were anonymized and the names were replaced by codes so that during the research, the researchers would not see any names.
4. The software application used to harvest data from Facebook was coded based on the website's terms and conditions. In fact, it would send a request to Facebook to receive some data at a time and it would gather the needed data by repeating this process. Therefore, the research team had no choice but to follow Facebook data harvesting terms and conditions.

Data Preparation

The two sets of data gathered in the abovementioned way were processed as follows.

Characteristics of the Nodes

The respondents were asked about their age, gender, marital status, education, the number of daily hours they used a computer, the number of daily hours they used different media, the number of books they read in a year and the main reasons why they used the Internet.

Also, for a very brief understanding of the respondents' personality traits, a brief test developed by Samuel D. Gosling and his colleagues (2003) was used. The test is a very brief measure of the Big-Five personality domains which includes 10 questions to measure the (1) respondent's extraversion, (2) agreeableness, (3) conscientiousness, (4) emotional stability and (5) openness to experience.

Characteristics of the Facebook posts

The research team gathered 591 Facebook posts. Prior to studying the probable relations between the characteristics of these posts and the other variables used in the research, characteristics of the posts had to be defined and the posts had to be coded. It was carried out through two stages of processing.

a) First processing stage

The authors along with two assistant researchers studied the posts, looking for common attributes. They eventually proposed 64 attributes as the characteristics of the materials posted on Facebook (here called *Facebook posts*). Through the coding process the operational definitions of the attributes were revised several times, thus 23 non-practical characteristics had to be omitted, leaving 41 final *post characteristics*. The coding process included judging a post for having or not having any of the 41 characteristics. For instance, any of the 591 posts were checked for having images (1) or not having images (0); including advertisement (1) or not including advertisement (0); etc.

All the posts were coded for having or not having any of the 41 final characteristics. The process of coding 591 posts with 41 characteristics includes more than 24,000 instances of decision making.

Two assisting researchers cooperated in creating the characteristic titles and definitions. They also both did the coding, deciding whether or not a characteristic existed in each post. Through parallel coding, discussion and repetition of the coding of the posts that were already coded by the other researcher, the researchers managed to decrease the heterogeneity of the results of their work to less than 2%. Also Cohen's Kappa was calculated to insure interrater agreement and the reliability of the coding results.

$$k = (Pr(a) - Pr(e)) / (1-Pr(e))$$

The calculated Kappa was over 0.86, which shows excellent interrater agreement.

The final list of 41 characteristics included: *photo of famous people, pictures (excluding photos of famous people), questions or requests for comments, jokes, satire, advertisement, news, personal opinions, poems or literature, aphorism, quotes from famous people, quotes from sources, psychological issues, political issues, economic issues, religious (or anti-religious) issues, social and cultural issues, literary materials, artistic materials, scientific issues, environmental issues, family relationships,*

relations with the opposite sex, spiritual emotions, expression of sorrow or regret, nostalgic materials, warning, emotional materials, advice, request for like or share, hopeful materials, insult, reasoning and analysis, disappointing materials, admiration of the current politicians or political system of Iran, admiration of individuals, criticism of Iran or Iranians, criticism of the politicians or political system of other countries, criticism of the current politicians or political system of Iran, criticism of a social group, criticism of individuals.

b) Second processing stage

With 41 characteristics it is difficult to develop hypotheses or understand and use the results. Classification may prove useful here. The researchers cooperated in classifying the 41 characteristics into 6 categories as follows[1]:

Form: photo of famous people, and pictures (excluding photos of famous people).

Subject: psychological issues, political issues, economic issues, religious (or anti-religious) issues, social and cultural issues, scientific issues, relations with the opposite sex, family relationships, environmental issues, literary materials, news, request for like or share, and questions or requests for comments.

Form of Expression: disappointing materials, warning, expression of sorrow or regret, emotional materials, spiritual emotions, advice, nostalgic materials, jokes, satire, poems or literature, insult, hopeful materials, reasoning and analysis, artistic materials, aphorism, and advertisement.

Source: quotes from famous people, quotes from sources, and personal opinions**.**

Praise: admiration of the current politicians or political system of Iran, and admiration of individuals.

Criticism: criticism of individuals, criticism of a social group, criticism of the current politicians or political system of Iran, criticism of the politicians or political system of other countries, and criticism of Iran or Iranians.

1. We were not able to find a standard system of categorization by which previous studies classified texts and materials. The researchers looked for similarities in the characteristics and used common sense to classify the 41 characteristics into a limited number of groups. We are aware that ultimately all these categories have been partly shaped by the sample: we studied hundreds of Facebook posts and the frequent types of materials led us to the final list of 41 characteristics. Eventually, the similarities between these 41 characteristics led us to the final list of 6 broader groups. Perhaps, future studies can test the meaningfulness of these categories.

Research Question

The abovementioned procedures of data-gathering and data-processing resulted in two sets of data (characteristics of the Facebook users, characteristics of the Facebook posts) and the research hopes to answer a question by studying the relationships between them.

RQ: In a given Facebook society are there significant relations between the characteristics of the posts in terms of *form*, *subject*, *form of expression*, *source*, and existence of *praise* and *criticism* on one hand and the characteristics of the people who comment on them in terms of general *demographics*, *media consumption* and *personality traits* on the other?

Provided that many such significant relations are found, if we have enough information on a Facebook user, we can predict what types of material they are more likely to comment on. Or by knowing enough about a Facebook post we can predict some common characteristics of the people who would comment on it.

Obviously the goal of this research is not to provide us with a comprehensive list of characteristics that enable us to make precise predictions in different networks. The study will try to test the practicality of this approach by showing the existence of significant relations. If proved practical, future research would be able to use this approach in the study of information flow.

Few Notes on Methodology

Most studies on social networks take one of two approaches. One approach, which is the older one, considers social networks as containers that hold huge amounts of data, through which one could read what is on people's minds or examine different social attitudes, and trends. The second approach is the more recent one - namely Social Network Analysis - which is concerned with the structure of the network and tries to understand it through the investigation of its components (nodes and the edges) and their positions in the network.

None of these approaches are exactly the one used in this study (although one could argue that the approach taken in this research is closer to that of the first type). SNA is different from older methods of sampling and analysis as it takes *the position* of the nodes into consideration. It is important because study has shown that a node's location within a network (described by the number of its connections and the kind of nodes it's connected to) can significantly change the way its actions and reactions affect the overall outcome of the network.

However, not every network-related issue can be described by drawing a map of the network, its components, and connections. Consider Google search as a major form of flow of information between the nodes. For instance, assume you are looking for a specific food recipe. You search "recipe for ..." on google. The search directs you to a website, you receive the needed information and close the page. What led you (as a node on the network) to that specific website (as another node of the network) was not a systematic relation between you and the website but a specific need on your side and a specific content on the side of the website (not to underestimate the set of rules and algorithms based on which the search engine works).

This issue can be the subject of a long discussion and scientific examination of the network. However, we should bear in mind that older methods of content analysis and surveying are still very useful to understand much of what is going on, on the Internet and a combination of these classical methods is what this research uses. However, this research is not concerned with the trends and concepts found in the body of data that was gathered, rather it focuses on the relations: relations between the type of people and the type of material they have reacted to.

Clearly each of these methods has its own uses and advantages. We should be aware that by treating the nodes of the network as equally influential and by treating Facebook posts (and the pages they are posted on) as if all Facebook posts and pages receive equal attention, some influential factors/variables can remain hidden from the study.

Data Analysis

The statistical analysis of the relations between the two sets of data indicated several significant relations. To test the significance of the relations, Pearson's Chi-square test was used and the following reported results only include the ones at least 95 percent reliable. The Chi-square test showed more than 99-percent significance for many of the reported relations.

Results

The study of the relations between the characteristics of the users and the characteristics of the posts they commented on showed at least 21 significant relations. A synopsis of the results has been presented in the following table.

Table 1. Node Characteristics × Message Characteristics

Messages Containing ↓ / Users' Characteristics →		Demographics: Time Spent Online	Demographics: Education	Demographics: Age	Demographics: Marital Status	Demographics: Gender	Media Consumption: Primary Source of News	Media Consumption: Reading Press	Media Consumption: Online Age	Media Consumption: Watching TV	Personality Traits: Being Critical and Quarrelsome	Personality Traits: Extraversion and Enthusiasm	Personality Traits: Anxiousness, Being Easily Upset	Details →
Form	Pictures (excluding photos of famous people)					X								Male (50%), Female (65.3%)
	Photos of Famous People										X			Average (24.6%), High (40.7%)
Subject	Political Issues							X						Never, Rarely (22%), Sometimes, Once a week (27.8%), Two or three times a week or Daily (42.6%)
	Social and Cultural Issues					X								Male (35.4%), Female (16.7%)
												X		Low (52.5%), Average (42.8%), High (27.4%)
						X								Male (47.2%), Female (25.9%)
	Questions or Request for Comments				X									Single (16.9%), Married (33.3%)
	News										X			Average (6.5%), High (19.4%)
Form of Expression	Reasoning and Analysis								X					3 – 5 years (11.5%), More than 5 years (34.5%)
					X	X								Male (37.8%), Female (14.8%)
	Emotional Materials				X									Single (16.9%), Married (33.3%)
							X							Internet (76.7%), Other (60%)
Source	Personal Opinions		X											High school or less (42.8%), Some College or Bachelor's (70.3%), Masters or PhD (85.4%)
	Quotes (from famous people or sources)									X				1 hour a day or less (51.7%), 2 or 3 hours a day (27.1%), 4 hours a day or more (41.7%)
				X					X					3 – 5 years (3.8%), More than 5 years (23.8%)
				X										20 or Younger (13.8%), 21 – 30 (50.4%), 31 – 40 (44.4%)
						X								Male (51.2%), Female (25.9%)
											X			Average (34.4%), High (51.4%)
		X												1 or 2 hours a day (3.3%), 3 or 4 hours a day (25%), 5 hours a day or more (22.9%)
													X	Low (30.5%), Average (15.3%), High (15.1%)
Criticism	Criticism of a Social Group					X								Male (5.7%), Female (17.3%)

As an example the relations between the *characteristics of the Facebook users* and the *subject* of the posts they commented on will be explained. In the section, where subject and demographics cross, three cells have been specified, which means there have been three significant relations between the subject of the Facebook posts and the general demographics of the users who commented on them.

The three relations are as follows: there was a significant relationship between the gender of the users and their tendency to comment on political issues. 35.4% of the male users who participated in the study commented on the posts that contained a political issue while 16.7% of the female participators commented on such posts. This shows that the tendency of the male users to comment of political issues was almost twice the tendency of the female users to comment on such issues. Similarly male users were considerably more inclined to comment on social and cultural issues.

Another significant relation here was between marital status and the tendency to comment on a post that included a question or a request for comments. Married users were almost twice likely to comment on such posts.

Where the rows related to the *subject* of the Facebook materials and the columns related to the users' *media consumption* cross, one cell has been marked. It shows that there was a significant relationship between the users' likelihood to comment on political messages and how frequently they read newspapers or magazines. There is a direct and strong relationship. 22% of those who never or rarely read newspapers or magazines commented on political messages. For those who read newspapers or magazines sometimes or once a week, the number reaches 27.8%. This is while over 42% of the people who read newspapers or magazines two or three times a week commented on political messages. In other words there was a direct relation between the frequency of reading newspapers or magazines and the users' tendency to comment on political messages.

When it comes to the relations between the *subject* of the messages and the participants' *personality traits* there were two significant relations. There was a significant reverse relation between the participant being *extravert and enthusiastic* and their tendency to comment on *social and cultural issues*. Also, *critical and quarrelsome* users were almost three times more likely to comment on Facebook messages that included a *news story*.

One way to use the table of results is to consider all the significant relations in a column. For instance if the creator of a message plans to

target male users they can try using (1) more political issues, (2) more social and cultural issues, (3) more reasoning and analysis, (4) more quotes from famous people and sources and (5) less criticism of social groups[1]. However, if the creator of a message plans to target female users probably (1) more pictures, (2) less political issues and (3) less analysis-based arguments can be helpful.

One should be careful while trying to interpret the statistical results. For instance, it was observed that almost 51 percent of the male users and only less than 26% of the female users had commented on materials tagged with *quotes (from people or other sources)*. One may read this as the existence of references discourages women from commenting on a Facebook post. Such interpretations can be misleading.

First, it is possible that materials with or without references are significantly different in other ways too. The absence and existence of references can be in significant relation with other hidden variables and in fact woman and men may have reacted differently to the messages because of those variables.

Second, the existence of references in the messages may have encouraged comments from men and women differently, but from that we cannot simply assume that the existence of references has discouraged woman from commenting on a message. The rest of the results will not be explained here. They could be understood from the table.

Discussion

There were 21 significant relations between the characteristics of Facebook users on one hand and the types of material to which they reacted, on the other. As it can be seen in the table, user characteristics can be classified in three groups as follows.

General demographics: age; gender; marital status and education.

Media consumption: time spent online; time spent reading press; time spent watching TV; the nodes' primary source of news, and online age (the number of years he or she has used the Internet).

The nodes' personality traits: 'extraversion and enthusiasm'; 'anxiousness, getting easily upset'; 'being disorganized, careless'; 'being conventional and uncreative' and 'being critical and quarrelsome'.

1. The results regarding the relationship between the *likelihood of commenting* on one hand and *criticism of a social group* on the other, might not be very useful because we can't judge at this point if this would be true about a specific social group or just any social group. Perhaps we should have considered this while classifying the post characteristics.

This can work as a guide for researchers seeking more detailed, more comprehensive or more practical relationships. In fact, it was shown that other than general demographic information of the nodes, their media consumption and their psychological states can be used to explain or predict their behavior on social networks.

In terms of psychology, for example, a very brief test of personality traits was used which lacks a high level of accuracy and does not cover all the important personality traits. Studies that borrow more from psychology, by scholars more familiar with the field, may give us deep insight and powerful tools to explain and predict network behaviors based on the psychological traits of the human nodes acting in a network.

This study was unable to find any significant relationships between some characteristics that one might expect. One can guess there are relationships between people's general knowledge and the number of books they read. On the other hand, it is likely that there are relationships between people's general knowledge and the types of material they would react to. However, the study did not see any relationships between the users' network behaviors and the number of books they read. This may be explained by further studies that take into consideration the *type* of books that people read rather than the sheer numbers.

Conclusion

As argued, due to the changing dynamics of our network society, there is an increasing need to focus on the relations between the nodes, their network behaviors and the messages flowing in the network. The current study showed that there are measurable relations between the characteristics of the nodes on one hand and the characteristics of the messages they would react to on the other.

The purpose of this explorative study was not to provide us with an easy-to-use tool to calculate the extent and duration of distribution of a given piece of information based on its characteristics in all societies. First, as much as it may sound ideal, a high level of prediction, if possible, would need many other studies to contribute to our understanding of the relations between the nodes and the messages flowing in the network.

Second, from one society to another and from one network setting to another and even maybe from one time to another, the rules and patterns may significantly vary. Many studies are needed to understand the dynamics of the relations between people and the types of messages they run through their networks. However, universal rules and patterns may also be found.

The two concepts of *node characteristics* and *message characteristics*– which was also referred to as *characteristics of the units of information* are general concepts and other studies may be able to define them better and break them into more practical variables.

The fact that this study used Farsi Facebook pages does not mean that one should consider Iranian pages as a sub-case of Facebook. In different countries, Facebook may operate differently but since this study is concerned with *type of people– type of material* relationships, limiting the population by language, country and other factors could benefit the study by limiting the diversity of cases, especially considering the limited scale of the research.

The main goal sought by this study was to propose an approach and method to analyze the social information network and examine its practicality. Arguably the study was able to show that this approach can be practical and that by performing enough studies on a network, the power to explain, predict and even influence its outcomes and processes can be achieved.

Future works will not and should not be limited to Facebook. Other than promoting our knowledge on the social information network, the results gained by this study and similar future works can be used in different ways. If we have enough information about a society, the following tasks should be feasible:

1. Using the results of the study, we can make specific materials with specific characteristics and post them on a social network to target a specific group of people. If we want to send a message to older people, for instance, we can include features in the message which study has proved to make them more *react-able* to older people. If this sounds too ambitious, at least we can use the outcomes of this study and similar future works to *explain* why specific people reacted more or less to specific materials.
2. By analyzing the materials written by the nodes of a network, we can guess what groups of people were involved in writing the materials and reacting to them.

In human societies, all explanations and predictions are presentable and understandable in terms of probabilities. The approach proposed by this study can be used as a practical tool in calculating the probabilities of actions, reactions and results in different networks.

If fact, the present paper argued that in the study of flow of information other than performing structural studies (like what is done in social network analysis - SNA), we should try to calculate the probability of specific transmissions.

This work remains limited to the online world which does not contain the entire flow of information in our lives. Proper scholarly work such as that of Lane and her colleagues (2016) have used social network sites to compare people's online and offline characteristics and/or behaviors. Other works can be carried out in order to shed more light on the flow of information in our offline/physical world.

Limitations

Although this study does not try to make general claims about Facebook users, considering the huge population who use Facebook (even if we limit ourselves to Farsi pages) a bigger sample would have been an advantage. Considering the limitations of the research and also the users' privacy concerns it was not easy to have many more questionnaires filled. Future studies that benefit from a different and larger sample may demonstrate how the size of the sample affected the results of this study.

Acknowledgment

The authors would like to thank Iran's National Elites Foundation for their cooperation and support without which this research would not have been possible.

Ms. Saeedeh Zadghanad and Ms. Najmeh Mohammadkhani spend dozens of hours cooperating with the authors of the paper. Their time and efforts are highly appreciated.

References

Besley, J.C. & Baxter-Clemmons, S. (2010). Analysis of South Carolina hydrogen and fuel cell workers views and opinion leadership behavior: A waiting opportunity? *International Journal of Hydrogen Energy*, 8407-8416. doi:10.1016/j.ijhydene.2010.06.002.

Camarero, C. & San José, R. (2011). Social and attitudinal determinants of viral marketing dynamics. *Computers in Human Behavior*, 27(6): 2292-2300. doi:10.1016/j.chb.2011.07.008.

Chafe, W. (1987). *Cognitive constraints on information flow*. Coherence and Grounding in Discourse, 21. doi:10.1075/tsl.11.03cha.

Gosling, S.D., Rentfrow, P.J. & Swann Jr., W.B. (2003). A very brief measure of the Big-Five personality domains. *Journal of Research in Personality,* 37(6):504–528.doi:10.1016/s0092-6566(03)00046-1.

Granato, J. & Krause, G.A. (2000). Information diffusion within the electorate: the asymmetric transmission of political–economic information. *Electoral Studies,* 19(4): 519–537. doi:10.1016/s0261-3794(99)00027-x.

Granato, J., Lo, M. & Wong, M.C.S. (2011). Modeling and testing the diffusion of expectations: An EITM approach. *Electoral Studies*, 30(3): 389-398. doi:10.1016/j.electstud.2010.11.003.

Kaplan, A.M. & Haenlein, M. (2011). Two hearts in three-quarter time: How to waltz the social media/viral marketing dance. *Business Horizons*, 54(3): 253-263. doi:10.1016/j.bushor.2011.01.006.

Lane, B.L., Piercy, C.W. & Carr, C.T. (2016). Making it Facebook official: The warranting value of online relationship status disclosures on relational characteristics. *Computers in Human Behavior,* 56: 1-8. doi:10.1016/j.chb.2015.11.016.

Lazarsfeld, P.F., Berelson, B. & Gaudet, H. (1944). *The people's choice: how the voter makes up his mind in a presidential campaign.* Columbia University Press.

Lehman, M. & Burke, T.J. (1981). *Communication technologies and information flow.* New York: Pergamon Press.

Luce, R.D. (1953). *Information flow in task-oriented groups.* Cambridge, Mass: Research Laboratory of Electronics, Massachusetts Institute of Technology.

Pescher, C. & Spann, M. (2014). Relevance of actors in bridging positions for product-related information diffusion. *Journal of Business Research*, 67(8): 1630–1637. doi:10.1016/j.jbusres.2013.09.005.

Pescher, C., Reichhart, P. & Spann, M. (2014). Consumer Decision-making Processes in Mobile Viral Marketing Campaigns. *Journal of Interactive Marketing*, 28(1): 43-54. doi:10.1016/j.intmar.2013.08.001.

Ramirez, S., Dwivedi, P., Ghilardi, A. & Bailis, R. (2014). Diffusion of non-traditional cookstoves across western Honduras: A social network analysis. *Energy Policy*, 66: 379-389. doi:10.1016/j.enpol.2013.11.008.

Reitman, R.P. (1978). *Information flow in parallel programs: An axiomatic approach.* Ithaca: Dept. of Computer Science, Cornell University.

Sabbar, S. & Hyun D. (2016). What makes it likeable? A study on the reactions to messages in a digital social network: the case of Facebook in Farsi. *SpringerPlus*, 5*: 2103*. https://doi.org/10.1186/s40064-016-3771-3.

Schmitt-Beck, R. & Mackenrodt, C. (2010). Social networks and mass media as mobilizers and demobilizers: A study of turnout at a German local election. *Electoral Studies*, 29(3): 392-404. doi:10.1016/j.electstud.2010.03.011.

Subramanian, R. & Katz, E. (Eds.). (2011). The Global Flow of Information. doi:10.18574/nyu/9780814748114.001.0001.

Torrente, E., Martí, T. & Escarrabill, J. (2012). A breath of Twitter. *Revista Portuguesa de Pneumologia*, 18(3): 137-141. doi:10.1016/j.rppneu.2012.02.007.

Tufekci, Z. & Wilson, C. (2012). Social media and the decision to participate in political protest: Observations from Tahrir Square. *Journal of Communication,* 62(2): 363–379. doi:10.1111/j.1460-2466.2012.01629.x.

Valenzuela, S., Park, N. & Kee, K.F. (2009). Is there social capital in a social network site?: Facebook use and college students'Life satisfaction, trust, and participation. *Journal of Computer-Mediated Communication,* 14(4): 875–901. doi:10.1111/j.1083-6101.2009.01474.x.